Project Lead The Way® "Principles of Engineering"
Technology Education – Applied Technology Education
Utah State Office of Education
CIP Code 210122

COURSE DESCRIPTION: This course provides an overview of engineering and engineering technology. Students develop problem-solving skills by tackling real-world engineering problems. Through theory and practical hands-on experiences, students address the emerging social and political consequences of technological change. The course of study includes:

- Overview and Perspective of Engineering. Students learn about the types of engineers and their contribution to society.
- Communication and documentation. Students collect and categorize data, produce graphic
- Design Process. Students learn about problem solving and how products are developed to include how engineers work in teams. representations, keep an engineer's notebook, and make written and oral presentations.
- Engineering Systems. Students learn about mechanical, thermodynamics, fluid, electrical, and control systems.
- Statics. Students learn about measurement, scalars and vectors, equilibrium, structural analysis, and strength of materials.
- Materials and Materials Testing. Students learn the categories and properties of materials, how materials are shaped and joined, and materials testing.
- Engineering for Quality and Reliability. Students will use precision measurement tools to gather and apply statistics for quality and process control. Students will also learn about reliability, redundancy, risk analysis, factors of safety, and liability and ethics.
- Dynamics. Students will be introduced to dynamics/kinematics.

STANDARD & OBJECTIVES

210122.01 OVERVIEW AND PERSPECTIVE OF ENGINEERING. STUDENTS LEARN ABOUT THE TYPES OF ENGINEERS AND THEIR CONTRIBUTION TO SOCIETY.

210122.0101 Students will have an understanding of engineering and be able to identify engineering achievements through history. (Engineers as Problem Solvers)
210122.0102 Students will be able to identify five historical engineering role models, including minorities and women. (Engineers as Problem Solvers)
210122.0103 Students will be able to identify problems for engineers to solve in the future. (Engineers as Problem Solvers)
210122.0104 Students will be able to define attributes associated with being a successful engineer. (Engineers as Problem Solvers)
210122.0105 Understand that an engineering team must work together to solve problems, with each team member having individual and collective responsibilities. (Engineering Team)
210122.0106 Understand the role of out-sourcing in the engineering process, and how effective communication is essential. (Engineering Team)
210122.0107 Understand how gender-bias, racial-bias and other forms of stereotyping and discrimination can adversely affect communications within an engineering team. (Engineering Team)
210122.0108 Understand how ethics influences the engineering process. (Engineering Team)

210122.0109 Understand how social, environmental and financial constraints influence the engineering process. (Engineering Team)
210122.0110 Students will have an understanding of the difference between engineering disciplines and job functions. (Careers in Engineering)
210122.0111 Students will understand the professional and legal responsibilities associated with being an engineer. (Careers in Engineering)
210122.0112 Students will research and discover the educational requirements to become an engineer. (Careers in Engineering)
210122.0113 Students will become familiar with an area of engineering by preparing for and conducting an interview with an engineer in that field of engineering. (Careers in Engineering)

210122.02 COMMUNICATION AND DOCUMENTATION. STUDENTS COLLECT AND CATEGORIZE DATA, PRODUCE GRAPHIC

210122.0201 Students will compose sketches use proper sketching techniques in the solution of design problems. (Sketching)
210122.0202 Students will select the appropriate sketching styles for presentation of a design problem to a group. (Sketching)
210122.0203 Students will use proper proportioning while producing annotated sketches. (Sketching)
210122.0204 Students will plan and compose a written technical report about the research they conduct about a career field in engineering. (Technical Writing)
210122.0205 Students will be able to formulate an organized outline for a technical paper. (Technical Writing)
210122.0206 Students will be able to design and create tables, charts, and graphs to illustrate data they have collected. (Data Representation and Presentation)
210122.0207 Students will evaluate and select an appropriate type of table, chart, or graph to accurately communicate collected data for written work or presentations. (Data Representation and Presentation)
210122.0208 Students will design and deliver a presentation utilizing appropriate support materials about research they have conducted. (Presentation)
210122.0209 Students will create and assemble support materials to appropriate demonstrate concepts used in their presentations. (Presentation)

210122.03 DESIGN PROCESS. STUDENTS LEARN ABOUT PROBLEM SOLVING AND HOW PRODUCTS ARE DEVELOPED TO INCLUDE HOW ENGINEERS WORK IN TEAMS. REPRESENTATIONS, KEEP AN ENGINEER'S NOTEBOOK, AND MAKE WRITTEN AND ORAL PRESENTATIONS.

210122.0301 Students will compose and diagram the product development lifecycle of an invention of their choice and report findings to the class. (Design Process)
210122.0302 Students will trace the history of an invention and evaluate its effects on society and the environment. (Design Process)
210122.0303 Students will examine the evolution of an invention to observe and report on how the design process is applied to continuously redesign and improve the product. (Design Process)

210122.04 ENGINEERING SYSTEMS. STUDENTS LEARN ABOUT MECHANICAL, THERMODYNAMICS, FLUID, ELECTRICAL, AND CONTROL SYSTEMS.

210122.0401 Students will identify and explain the function of the essential components of a mechanical system on a display they create. (Mechanisms)
210122.0402 Students will create a display of a mechanical system from a household item they disassemble. (Mechanisms)
210122.0403 Students will mathematically explain the mechanical advantage gained and explain the function of the six different types of simple machines in a presentation on the SMET device. (Mechanisms)
210122.0404 Students will apply simple machines to create mechanical systems in the solution of a design problem. (Mechanisms)
210122.0405 Students will conduct an energy analysis on a section of their home and calculate the heat loss through walls and windows. (Thermodynamics)
210122.0406 Students will develop effective presentation skills. (Thermodynamics)
210122.0407 Students will research and evaluate systems undergoing thermodynamic cycles for efficiency and present findings to the group. (Thermodynamics)
210122.0408 Students will give an oral presentation incorporating the first and second laws of thermodynamics, describing the concept and function of a heat engine of their choice. (Thermodynamics)
210122.0409 Students will evaluate and select specific fluid power sources for different functions. (Fluid Systems)
210122.0410 Students will create a flow diagram schematic sketch and compare it to an actual fluid power circuit during a presentation to the class. (Fluid Systems)
210122.0411 Students will mathematically calculate and explain the work being done by a specific fluid power device as part of an oral presentation. (Fluid Systems)
210122.0412 Students will safely demonstrate proper setup and adjustment of a fluid power system. (Fluid Systems)
210122.0413 Students will create schematic drawings to facilitate experimental measurements of electrical circuits. (Electrical Systems)
210122.0414 Students will apply ohm's and watt's laws in designing safe electrical circuits. (Electrical Systems)
210122.0415 Students will appraise community needs and evaluate the impact supplying electrical generation has on their communities. (Electrical Systems)
210122.0416 Students will be able to estimate current consumption by a circuit and be able to compare estimates to accurate measurements they perform. (Electrical Systems)
210122.0417 Students will design, diagram and implement a program to control a device they construct to perform a sorting operation. (Control Systems)
210122.0418 Students will select and apply concepts of mechanical, electrical, and control systems in solving design problems. (Control Systems)
210122.0419 Students will formulate a plan for evaluating the functioning of their sorting device and to make appropriate changes in design, circuitry or programming. (Control Systems)
210122.0420 Students will demonstrate and defend their solution to the design problem in an oral presentation to the class. (Control Systems)

210122.05 STATICS. STUDENTS LEARN ABOUT MEASUREMENT, SCALARS AND VECTORS, EQUILIBRIUM, STRUCTURAL ANALYSIS, AND STRENGTH OF MATERIALS.

210122.0501 Students will mathematically analyze a simple truss to determine types and magnitude of forces supported in the truss. (Statics)
210122.0502 Students will design, construct and test a model bridge to support the greatest amount of weight per gram of bridge mass. (Statics)

210122.0503 Students will prepare and present a mathematical analysis of a truss design as part of a 5 minute oral presentation about their bridge design. (Statics)
210122.0504 Students explain the use of factors of safety in the design process.
210122.0505 Students will be able to explain the difference between the area of a cross section of an object and the second moment of the area (Moment of Inertia) and predict the relative strength of one shape vs. another. (Strength of Materials)
210122.0506 Students will be able to use a computer aided engineering package to analyze a shape. (Strength of Materials)
210122.0507 Students will explain the effects that stress has on a material and explain how the material will react. (Strength of Materials)

210122.06 MATERIALS AND MATERIALS TESTING. STUDENTS LEARN THE CATEGORIES AND PROPERTIES OF MATERIALS, HOW MATERIALS ARE SHAPED AND JOINED, AND MATERIALS TESTING.

210122.0601 Students will be able to identify and differentiate the five basic categories of solid engineering materials. (Categories of Materials)
210122.0602 Students will be able to compare and contrast the physical properties of organic, metals, polymers, ceramics, and composites. (Categories of Materials)
210122.0603 Students will be able to trace the production of raw material to finished product. (Categories of Materials)
210122.0604 Students will be able to identify practical applications of each material category to engineered products and processes. (Categories of Materials)
210122.0605 Students will be able to collect, analyze, and test samples of the four basic materials. (Categories of Materials)
210122.0606 Students will be able to document and present laboratory data related to studies of material classifications. (Categories of Materials)
210122.0607 Students will be able to identify and document the properties of materials. (Properties of Materials)
210122.0608 Students will be able to design an experiment to identify an unknown material. (Properties of Materials)
210122.0609 The student will be able to formulate conclusions through analysis of recorded laboratory test data for presentations in the form of charts, graphs, written, verbal, and multi-media formats. (Properties of Materials)
210122.0610 Students will be able to analyze word problems about forces acting on materials. (Properties of Materials)
210122.0611 Students will be able to define and state examples of the major categories of Production Processes. (Production Process)
210122.0612 Students will be able to analyze a component of a product and describe the processes used in its creation.
210122.0613 Students will be able to interpret a drawing and produce a part. (Production Process)
210122.0614 Students will give an oral presentation on the production processes used to create products from a category of materials and a demonstration about one of the processes. (Production Process)
210122.0615 Students will be able to state the difference between mass and weight. (Quality Assurance)
210122.0616 Students will be able to utilize a variety of precision measurement tools to measure appropriate dimensions, mass, and weight. (Quality Assurance)

210122.0617 Students will be able to understand and explain why companies have a need for quality control and will describe what customers and companies refer to when the term “quality” is used. (Quality Assurance)
210122.0618 Students will be able to calculate the mean, median, mode, and standard deviation for a set of data and apply that information to an understanding of quality assurance. (Quality Assurance)
210122.0619 Students will be able to explain the difference between process and product control. (Quality Assurance)
210122.0620 Students will be able to distinguish between the characteristics of quality in a final product and the control of quality in each step of a process. (Quality Assurance)
210122.0621 Students will understand how control charts are used in industry and will be able to predict whether a process is “out of control,” or not by using a control chart. (Quality Assurance)
210122.0622 Students will be able to describe and safely conduct destructive and non-destructive material testing and will be able to use the data collected through these tests to compute and document mechanical properties. (Material Testing Processes)
210122.0623 Students will be able to analyze a product that breaks and be able to explain how the material failed. (Material Testing Processes)

210122.07 ENGINEERING FOR QUALITY AND RELIABILITY. STUDENTS WILL USE PRECISION MEASUREMENT TOOLS TO GATHER AND APPLY STATISTICS FOR QUALITY AND PROCESS CONTROL. STUDENTS WILL ALSO LEARN ABOUT RELIABILITY, REDUNDANCY, RISK ANALYSIS, FACTORS OF SAFETY, AND LIABILITY AND ETHICS.

210122.0701 Students will be able to diagram a system and identify the critical components. (Reliability)
210122.0702 Students will be able to mathematically estimate chance of failure of a system given information on certain components. (Reliability)
210122.0703 Students will list the causes of failure and be able to propose solutions. (Reliability)
210122.0704 Students will prepare and defend a position on an ethical engineering dilemma. (Reliability)
210122.0705 Students will research the engineering, legal, social, and ethical issues related to a final design developed in a case study. (Case Study)
210122.0706 Students will analyze an engineering failure for the purpose of presenting an aural report which identifies; causes, damage done, design failures, and other areas where the failure has impacted the environment or society. (Case Study)
210122.0707 Students will prepare a written report explaining their analysis of an engineering failure. (Case Study)

210122.08 DYNAMICS. STUDENTS WILL BE INTRODUCED TO LINEAR AND TRAJECTORY MOTION.

210122.0801 Students will be able to explain the difference between distance traveled and displacement.
210122.0802 Students will design and build a device for the purpose of conducting experiments of acceleration, displacement, and velocity.
210122.0803 Students will be able to explain how velocity and acceleration are calculated. (Trajectory Motion)
210122.0804 Students will be able to calculate range and initial acceleration from data they record from experiments. (Trajectory Motion)
210122.0805 Students will design and produce a three-fold pamphlet to include an explanation of their ballistic device, drawings and a summarization of data recorded from experiments. (Trajectory Motion)

210122.0806 Students will be able to analyze test data and utilize the results to make decisions. (Trajectory Motion)